Complications associated with fixed partial dentures with a loose retainer

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Statement of problem. When 1 retainer of a definitive fixed partial denture (FPD) becomes loose, the clinician has the option of either sectioning and removing the FPD or attempting removal of the intact cemented retainer. Excessive force during attempted FPD removal may irreversibly damage dentition.

Purpose. This study evaluated the type and frequency of complications that may accompany the removal of definitive cemented FPDs with a single loose retainer.

Material and methods. Participants included 22 patients with a definitive cemented FPD with complete cast crown coverage castings in which 1 retainer became loose and the other retainer remained cemented. Cemented FPD retainers were removed using 1 of 2 attachments supplied with a crown removal system (Dentco). The patient and FPD characteristics, type of attachment, number of attempts before removal, condition of removed FPD, and condition of the abutment teeth were recorded. Descriptive statistics were used to analyze the data.

Results. Clinical findings recorded prior to FPD removal showed that 41% of patients were unaware they had a loose FPD retainer and 82% reported no discomfort associated with the loose retainer. Caries were noted on 50% of the teeth with a loose retainer. Damage resulting from attempted removal of the cemented retainer included minor porcelain fracture (9%), minor core chipping (14%), minor incisal edge chipping of tooth preparations (27%), and major damage to the abutment tooth (4%).

Conclusion. Retrieval of an intact FPD and recementation was possible 64% of the time. (J Prosthet Dent 2006;96:245-51.)

CLINICAL IMPLICATIONS

Although the removal and recementation of an FPD is technically possible, abutment tooth caries under a loose retainer often limit the practicality of FPD removal procedures.

A frequent complication seen with a fixed partial denture (FPD) is a loosened retainer.[1] When an FPD retainer lacks retention, the clinician has several options. The most predictable approach is to section and remove the FPD, evaluate the abutments, and consider a new FPD. The primary disadvantage to this plan is the expense of fabricating a new FPD. An alternative approach is to attempt removal of the FPD by loosening the cemented retainer(s), with the aim of being able to recement the same FPD. However, the attempt to remove the cemented retainer can damage the abutment tooth or the FPD. If the clinician irreversibly damages tooth structure while attempting to salvage the FPD, a new FPD using the same abutments may not be possible, or worse, a new treatment plan may be required as a result of damage caused. Although techniques for removing a cemented FPD retainer have been suggested, few studies have outlined the complications associated with attempted removal of cemented FPD retainers.

Numerous clinical techniques have been suggested for removal of a definitively cemented crown or cemented retainer of an FPD. Suggested devices and techniques include use of a matrix band,[2] a hemostat,[3] a Richwil crown remover (Richwil Laboratories, Orange, Calif),[4] an acrylic resin mold compressed with a curved hemostat,[5] ultrasonics,[6] a prepared slot for a purchase point,[7] and a pneumatic crown remover. These techniques for casting removal have been reported to result in fractured porcelain margins or damage to preparation finish lines,[8] yet the frequency of these complications has not been reported.

Techniques advanced specifically for FPD removal have included the use of a wire and loop as a class 1 lever to elevate and remove an FPD.[9] Conny[9] suggested clinical judgment must be used with this technique to avoid irreversible damage to the supporting teeth. The use of various acrylic resin molds has also been suggested to protect porcelain surfaces and engage FPD pontic gingival undercuts while a prosthesis is tapped off.[7,10] Such acrylic resin molds offer clinicians the choice of an optimal purchase point for instruments and minimize the amount of force necessary for FPD removal.[10,11]

Only a limited number of investigators have evaluated the success of crown or FPD removal techniques.

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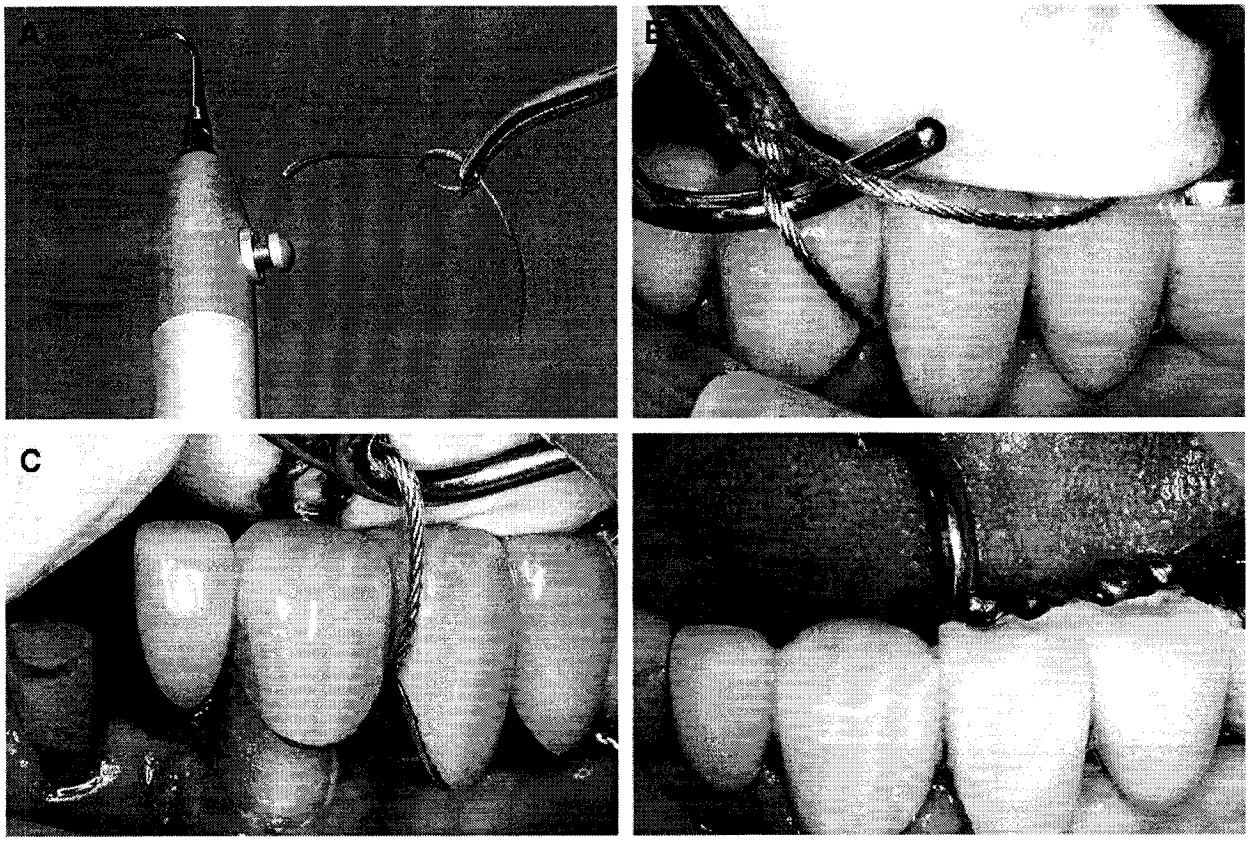

Fig. 1. Photographs illustrate instrument use for removal of only 1 FPD. **A,** For removal of cemented FPD retainers, Dentco crown removal instrument was used. **B,** Wire loop was passed under retainer and held by hemostats with J-shaped hook attachment used to engage wire loop. **C,** Successful removal of cemented retainer. **D,** J-shaped hook attachment was used directly in 10 patients.

In a study that evaluated the removal of 536 restorations using the Richwil crown remover (Richwil Laboratories), Oliva[4] determined that successful removal of definitively cemented crowns was possible 86% of the time, but only 72% of the time with an FPD. The Richwil crown remover, a pliable resinous material with strong adhesive properties, was used on 25 definitively cemented FPDs in the Oliva study. Unfortunately, Oliva did not state the frequency or type of complications associated with FPD removal attempts, but did state that removals were unsuccessful when the axial walls of abutment preparations were long and nearly parallel.

The loosening of an FPD retainer occurs with a frequency between 5%[12] and 12.6%,[13] with the highest incidence of loosening in the maxillary anterior region.[14] In a review of the literature, Goodacre et al[1] reported that the 3 most common complications following FPD treatment were caries (18%), the need for endodontic treatment (11%), and loss of retention (7%). Goodacre reported that 14 studies with an average duration of 8 years showed loss of retention in 7% of all patients with a cemented FPD. However, these findings may represent

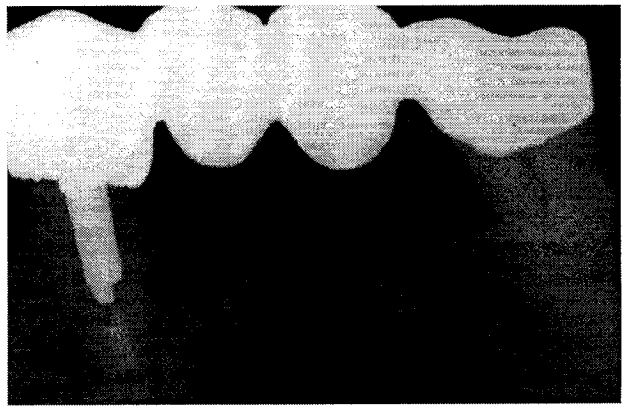

Fig. 2. Radiograph of FPD with large post in abutment tooth with cemented retainer. Due to large post, intact FPD removal was not attempted. Cemented FPD retainer was sectioned and removed.

an underestimation of loose retainers seen in patients with FPDs because a loose retainer is often not detected or treated.[13] This was shown by Karlsson,[13] who evaluated patients in active private practice recall and

Table I. Patient information and FPD characteristics

Patient	Gender	Age*	Years cemented†	No. of units/arch	Abutment loose	Patient aware of loose casting	Discomfort from loose casting	Loose abutment with RCT	Cemented abutment with RCT
1	F	53	8	3/Max	Posterior	Yes	No	Yes	Yes
2	M	47	9	4/Max	Anterior	Yes	No	Yes	Yes
3	F	63	5	4/Mand	Anterior	No	No	No	No
4	M	65	11	3/Max	Anterior	Yes	Yes	No	No
5	F	51	1	8/Max	NA*	Yes	No	No	No
6	F	49	5	5/Max	Anterior	Yes	No	Yes	No
7	F	60	10	6/Mand	NA*	No	No	No	No
8	M	84	2	4/Mand	Anterior	Yes	No	No	No
9	M	52	10	7/Mand	Posterior	Yes	Yes	No	No
10	M	50	7	4/Mand	Anterior	No	No	Yes	Yes
11	M	46	9	3/Max	NA*	Yes	No	No	No
12	M	43	4	4/Max	Anterior	Yes	No	Yes	Yes
13	F	36	7	11/Max	Posterior	No	No	No	No
14	M	63	10	3/Max	Anterior	Yes	No	No	No
15	M	40	6	3/Max	NA*	Yes	No	Yes	No
16	F	36	7	11/Max	Posterior	No	Yes	No	No
17	F	45	10	9/Max	NA*	Yes	Yes	No	No
18	F	53	3	8/Max	NA*	Yes	No	No	No
19	M	44	10	3/Mand	Posterior	No	No	No	No
20	M	71	15	3/Mand	Posterior	No	No	No	No
21	M	67	10	3/Max	Anterior	No	No	No	No
22	M	63	20	4/Max	Posterior	No	No	No	No

Max, Maxilla; *Mand,* mandible; *NA,* not applicable in patients with symmetric FPDs (for example, maxillary right canine to maxillary left canine).
*Average patient age was 54 years.
†Average length of service was 8.1 years. Years FPD had been in service was known in 15 patients and estimated in 7.

determined that 12.6% of the patients had an undiagnosed loose FPD retainer. A loose FPD retainer has been reported to occur more often if the retainer has had root canal treatment or if the retainer is the most posterior abutment.[13] The loss of retention of an FPD retainer occurs much more frequently than loss of retention in a single crown (7% vs. 2%).[15,16] It has also been reported that a loose FPD retainer is a more common early complication, whereas caries is a more common late complication.[11,13]

Although various techniques have been suggested for the removal of cemented FPD retainers, little information exists as to the condition of the abutment teeth at the time a loose retainer is diagnosed or the complications associated with attempted FPD removal. The purpose of this investigation was to detail the clinical findings in patients with a loose FPD retainer and outline the complications seen from the removal of a cemented retainer in 22 patients.

MATERIAL AND METHODS

Participating patients were from the graduate prosthodontics clinic at the University of California San Franciso (UCSF) and the private practice of 1 author. Approval for the study was obtained from the Human Subjects Committee at UCSF. The study was completed over a 5-year period from June 2001 to June 2006. Patients were not actively recruited; rather, when a patient presented with a loose FPD retainer, the patient was invited to participate in this study. Inclusion criteria included having a fixed partial denture and at least 1 loose retainer. Prospective participants agreed to have current radiographs of the involved dentition and a complete dental examination. For inclusion in the study, it was necessary for the loose FPD to have a cemented complete cast crown retainer. All patients agreed to accept the inherent risks associated with removal of a cemented FPD retainer. Subjects provided written informed consent.

Patients were excluded when clinicians believed removing the cemented FPD retainer was not in the best interests of the patient. Examples included situations in which the patient presented with obvious caries around the loose retainer and recementation of the same FPD would not be feasible even with successful FPD removal. Patients were also excluded when the abutment that required casting removal had a root canal and it was believed that the tooth would be at high risk for fracture, although having a root canal was not an absolute contraindication for participation. Patients were also excluded when a patient presented with diminished periodontal support and an attempt to remove the FPD would further compromise the tooth.

All cemented FPD retainers were removed using 1 of 2 attachments from the crown removal system (Dentco;

Table II. Removal settings and condition of removed FPDs

Patient	Removal settings			Condition of removed FPD			
	Attachment*	Setting	Attempts before removal†	Fractured porcelain	Other damage‡	FPD recemented	Comments
1	Wire loop	Medium	1	No	No	Yes	
2	Hook	High	6	Slight chip	No	Yes	Slight porcelain chip; able to recement
3	Wire loop	High	5	No	No	Yes	
4	Wire loop	Medium	5	No	No	No	Not recemented; caries of loose abutment
5	Wire loop	High	6	No	No	Yes	
6	Hook	Medium	4	No	No	Yes	
7	Wire loop	High	6	No	Yes	No	Not recemented; fractured abutment
8	Wire loop	Medium	4	No	No	No	Not recemented; fractured abutment
9	Wire loop	High	7	No	No	Yes	
10	Wire loop	Medium	4	No	No	Yes	
11	Hook	Medium	3	No	No	Yes	
12	Hook	High	5	Slight chip	No	Yes	Sight porcelain chip; able to recement
13	Wire loop	Medium	4	No	No	Yes	
14	Wire loop	High	5	No	No	Yes	
15	Hook	Medium	4	No	No	Yes	
16	Wire loop	Medium	3	No	No	Yes	
17	Hook	Medium	3	No	No	Yes	
18	Wire loop	High	3	No	No	No	Not recemented; decay of loose abutment
19	Hook	High	2	No	No	No	Not recemented; decay of loose abutment
20	Hook	Medium	5	No	No	No	Not recemented; decay of loose abutment
21	Hook	Medium	3	No	No	No	Not recemented; decay of loose abutment
22	Hook	High	5	No	No	No	Not recemented; decay of loose abutment

*Crown removal instrument had 2 attachments—wire loop or hook (Fig. 1).
†Average number of attempts was 4.2.
‡Refers to evaluation of observed damage to FPD metal structure, FPD margins, or abutment tooth preparations.

Dentco Corp USA, White Plains, NY), a J-shaped hook or a wire loop (Fig. 1). The Dentco crown removal instrument is pneumatically controlled and contains a mallet within the cylindrical handpiece. When activated, a counterweight is released, providing a sudden force designed to break the seal of the cemented casting. The instrument can be attached to the dental unit in place of a slow-speed handpiece for a source of compressed air. The instrument can be adjusted to deliver 3 levels of force: low, medium, and high. Two clinicians were involved in FPD removal and both adhered to the following protocol. For each patient the procedure was initiated with the low setting, and 2 FPD removal attempts were completed. Patient comfort was queried before the medium setting was used. If the patient was not comfortable with the continuation of removal attempts, the procedure was stopped. If the patient agreed to proceed, 2 attempts with the medium setting, followed by 2 attempts with the high setting as needed. Loose retainers were held down firmly by an assistant while the hook or loop attachments were used under the FPD adjacent to the cemented retainer. To the extent possible, the removal force was applied in the long axis of the cemented retainer being removed. Gauze was used to cover the opposing dentition to minimize unintended trauma to the opposing dentition.

The patient and FPD characteristics, type of attachment, number of attempts before removal, condition of removed FPD, and condition of the abutment teeth were recorded. Descriptive statistics were completed.

RESULTS

Thirty-one patients were considered for inclusion in this study based on the clinical finding of a loose FPD

Table III. Condition of teeth under loose retainer(s) and cemented retainer(s) after FPD removal

	Loose retainer(s)				Cemented retainer(s)				
Patient	Fracture of core	Fracture of tooth structure	Caries	Tooth sensitivity*	Fracture of core	Fracture of tooth	Caries	Tooth sensitivity†	Notes
1	No	No	Yes	No	Yes	No	No	No	Short post, minimal ferrule
2	No	No	No	No	No	No	No	Yes	Sensitivity resolved after 3 days
3	Yes	Yes	Yes	No	Yes	Yes	No	No	Minor fractures of core and tooth
4	No	No	Yes	Yes	No	No	No	No	Tooth sensitivity due to caries
5	No	No	No	No	No	No	No	No	
6	No	No	No	No	No	No	No	No	
7	No	No	No	No	No	Yes	No	Yes	Fractured tooth at gingival crest
8	No	Yes	No	Yes	No	No	No	No	Tooth sensitivity to sweets
9	No	No	Yes	No	No	No	No	No	
10	No	No	No	No	No	No	No	No	
11	No	No	No	No	No	No	No	No	
12	No	No	No	No	Yes	Yes	No	Yes	"Ache" resolved after 1 day
13	No	No	No	No	No	No	No	No	
14	No	No	No	No	No	No	No	No	
15	No	No	Yes	No	No	Yes	No	No	
16	No	No	Yes	No	No	Yes	No	No	
17	No	No	Yes	Yes	No	No	No	No	Tooth sensitivity to sweets
18	No	No	Yes	No	No	No	No	No	
19	No	No	Yes	No	No	No	No	No	
20	No	No	Yes	No	No	No	No	No	
22	No	No	Yes	No	No	Yes	No	No	Minor fracture of tooth

*Indicates sensitivity of tooth under loose retainer prior to FPD removal.
†Indicates tooth sensitivity of tooth under cemented retainer after FPD removal.

retainer. In 5 patients the tooth with the loose retainer showed clinical evidence of caries, and it was determined that the FPD could not be recemented even if the cemented retainer was successfully removed. Therefore, the FPDs for these 5 patients were sectioned and removed in pieces. For 2 patients, retainers were cemented to endodontically treated abutment teeth with large posts and little remaining tooth structure. Therefore, a clinical decision was made to not attempt removal because there was a high risk for abutment tooth fracture (Fig. 2). For 1 patient with considerable bone loss, removal of the FPD casting was not attempted because of the reduced periodontal support. One patient declined to have the FPD tapped off with the device because of the patient's concerns about potential complications. The remaining 22 patients participated in the FPD retainer removal study.

Table I presents the patient information and FPD characteristics of the 22 patients included in this study. Thirteen men and 9 women participated in the study, and the average age was 54 years. The average length of FPD service was estimated to be 8.1 years. This was based on knowing the length of service in 15 patients and estimating service length by patient report in 7 patients. The average FPD was 5.1 units in length and ranged from 3 to 11 units. The anterior retainer became loose more often (41%) than the posterior retainer (32%), with 27% of FPDs found to be symmetric (ie, an FPD from the maxillary right canine to the maxillary left canine). Forty-one percent of the patients were not aware that the FPD retainer was loose until informed by their dentists. Discomfort from the tooth with the loose abutment was reported by 18% of patients. Root canal treatment had been completed in 27% of the loose retainer abutments prior to FPD fabrication and in 18% of the cemented abutments.

Table II presents the removal settings and condition of the removed FPDs. The wire-and-loop attachment was used 55% of the time, and the hook attachment 45% of the time. None of the FPDs was successfully removed at the low setting. However, 55% of the FPDs were loosened using the medium setting, and 45% of the FPDs dislodged at the high instrument setting. The average number of removal attempts until FPD loosening was 4.2 attempts, and the range was from 1 to 7 attempts. Minor porcelain fractures occurred in 9% of patients. In 64% of the patients, abutment tooth conditions and removed FPDs were suitable for recementation.

Table III presents the condition of the abutment teeth after FPD removal. The FPD abutment with the loose retainer was evaluated after FPD removal and the following were observed: fracture of the core (4%), fracture of tooth structure (9%), caries (50%), and sensitivity prior to FPD removal (14%). The FPD abutment teeth with cemented retainers were evaluated after FPD

removal and the following were observed: minor fracture of core (14%), minor fracture of tooth structure (27%), major fracture of tooth structure (4%), and tooth sensitivity following FPD removal (14%).

DISCUSSION

Results from this study show 3 major findings. First, 41% of patients were not aware they had a loose FPD retainer until they were informed by their dentists. Second, although FPD removal resulted in mostly minor complications, irreversible damage involving the fracture of an abutment tooth at the gingival level did occur in 1 patient. Third, although recementation of the FPD was possible in 64% of the patients, a high percentage of patients had caries on the abutment tooth under the loose retainer that limited recementation.

Patients were often not aware that they had a loose FPD retainer. It was surprising to learn that 41% of the patients were not aware they had a loose FPD retainer until informed by a dentist. However, this finding is consistent with Karlsson,[13] who determined that patients in active recall in a private practice setting presented with a loose retainer in 12.6% of the FPDs at a 10-year follow-up. Equally surprising was that 82% of patients in the present study reported no discomfort associated with the loose retainer. Many patients reported awareness of a loose FPD retainer; but since there was no discomfort associated with the loose retainer, they did not feel an urgency to seek treatment.

Fixed partial denture removal resulted in primarily minor complications, but major complications did occur for 1 patient. Minor complications included porcelain chipping in 2 patients, minor fracture of the core in 3 patients, and a minor fracture of the tooth structure in 6 patients. Both porcelain fractures occurred when using the hook attachment, and the authors recommend using the wire-and-loop attachment rather than the hook attachment to avoid porcelain fracture. The minor fractures of the core and of the tooth structure did not limit the ability to recement the FPD.

One major complication observed involved fracturing a vital tooth at the gingival tissue level during crown removal attempts. This was patient 7 listed in the tables. The 6-unit FPD span extended from the mandibular left canine to the mandibular right canine, and the facture occurred using the high setting. Although the cemented abutment was vital, the tooth had a very long and parallel preparation with significant gingival recession. This clinical scenario might be considered a risk factor when attempting to remove a cemented retainer. This recommendation is consistent with the findings of Oliva,[4] who determined that unsuccessful FPD removal occurred with "excessively long and near parallel axial walls." Although fracture of the root was noted by Valderhaug[11] to be the underlying reason for FPD replacement in 3% of patients, the authors are not aware of other studies or clinical reports that have documented root fracture occurring during FPD retainer removal attempts.

Although the removed FPDs were recemented in 64% of the patients, decay in the loose retainer abutment was the most common reason the FPD could not be recemented. Often the decay in the loose retainer abutment was found to be much more extensive once the FPD was removed. It is recommended that abutments with loose retainers be critically evaluated prior to initiating crown removal procedures, because tooth structure under loose retainers was often more compromised than conditions indicated prior to FPD removal.

Many factors influence the feasibility of removing a definitively cemented FPD, including the accessibility of the restoration, the condition of the abutments, patient tolerance for a potentially unsettling procedure, and experience of the clinicians. It is important for clinicians to carefully monitor the force being applied. At times, it will be prudent to stop using force to remove a cemented abutment and remove the FPD in pieces. Results indicate that the condition of the abutment tooth beneath a loose retainer was the most limiting factor when considering recementation of a removed FPD.

Clinicians participating in the study reported that they felt higher levels of force were necessary to remove FPDs in the mandibular arch than those in the maxillary arch. This subjective report was substantiated by the data in that the high setting was required for removal in 40% of the maxillary FPDs and 57% of the mandibular FPDs. This finding could be related to inherent mandibular mobility, whereas the maxillary arch remains comparatively stable. Clinicians also indicated that having an assistant stabilize the position of the loose retainer during the removal procedures was important. Placing gauze on the opposing dentition is also important for preventing instrument damage to teeth in the opposing arch.

A number of factors were difficult to control and may have impacted study findings and limited the extrapolation of study results into general recommendations. The patients participating in this study were not randomly selected. As a consequence, no account was made for patients who had a loose FPD retainer but did not seek treatment. For example, patients with a clinical problem will often select a high-quality treatment center such as a dental school, and thus, this patient pool may not be representative of a general population of patients with a loose FPD retainer. Additionally, although the 2 clinicians primarily responsible for FPD removal followed the same protocol, slightly different approaches were invariably used by each clinician, so between and within operator variance in technique would add bias. For instance, the amount and direction of force applied during FPD removal were probably different because

dental-unit air pressure was not standardized. Consequently, the medium instrument setting at one dental operatory could differ from the medium instrument setting at a second operatory. Other uncontrolled variables include the type of cement initially used to cement the FPD, the adaptation of the retainer castings, the surface area of the castings, the parallelism of abutment tooth preparations, and the cooperation of the patient. Additionally, a learning curve accompanied the use of the instrumentation, so the results of others might differ from the results obtained in this study.

Future work will involve expanding the existing patient pool and carefully gathering information about the possible role that occlusion, differential mobility of abutments, and cements may have in the loosening of FPD retainers.

CONCLUSIONS

Within the limitations of this study, the following conclusions were drawn:

1. Forty-one percent of patients were not aware they had a loose FPD retainer until informed, and 82% of patients had no discomfort associated with a loose FPD retainer.
2. Fifty percent of the abutment teeth under loose retainers had caries. Caries was the single most limiting factor deterring the recementation of the FPD.
3. Recementation of removed FPDs was possible in 64% of the time.

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